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ATTOMOLE SENSITIVITY IN ISOTOPE TRACING USING ACCELERATOR MASS SPECTROMETRY.

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Accelerator Mass Spectrometry (AMS) facilities at LLNL are being used for ultra-low level tracing of compounds and elements in new applications to life science research. AMS was originally developed as a chronometry tool in earth sciences and archaeology, making special use of small carbon samples for radiocarbon dating. Although ^{14}C and ^{3}H are already used for tracing organic compounds, the high efficiency of AMS bestows a very large advantage in throughput and in precision over decay counting (on the order of 10^{6}). AMS is unrivaled for detecting ^{10}Be, ^{26}Al, ^{36}Cl, ^{41}Ca, and ^{129}I. The lifetimes of these isotopes ensure inefficiency in any method based on decay counting, and traditional mass spectrometry is unable to detect their very low concentrations in natural samples (10^{-10} - 10^{-15}). The use of AMS in detecting atto- to femto-moles of ^{14}C-labeled biomolecules from natural systems provides wide dynamic range and direct association of molecular fragments to parent compounds. AMS gives scientists a capability for determining the distributions and fates of chemical compounds and certain elements in natural systems at natural concentrations at a time when such data is required for rational risk determination, drug development, and regulatory justification.

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